STATE OF MARYLAND

DHMH

Maryland Department of Health and Mental Hygiene

Larry Hogan, Governor - Boyd Rutherford, Lt. Governor - Van Mitchell, Secretary

The Bureau of Environmental Health – Harmful Algae Bloom Surveillance

BLUE-GREEN ALGAE Q &A FOR WATER SYSTEM OPERATORS

Sassafras River 2008 Photo by Cathy Wazniak DNR

What are blue-green algae?

Blue-green algae, technically known as cyanobacteria, are microscopic organisms found naturally in lakes, streams and ponds. These algae are actually a primitive form of bacteria capable of photosynthesis. When present in large numbers they may form visible green, blue-green or reddish brown blooms that float on the surface of the water.

What are the health risks from blue-green algae?

Blue-green algae produce three types of toxins: neurotoxins, hepatotoxins, and dermatoxins (skin irritants). Neurotoxins affect the nervous system. Symptoms include muscle cramps, twitching, and in extreme case paralysis, cardiac or respiratory failure, and death. Hepatotoxins affect liver function. Symptoms include nausea, vomiting, diarrhea and, in extreme cases, even acute liver failure.
The World Health Organization (WHO) has established a health-based drinking water guideline f 1.0 ppb for one algal toxin, Microcystin-LR. The Australian standard is 1.3 ppb for total microcystins, while Health Canada has proposed a similar stand of 1.5ppb for total microcystins. Algal toxins are on the U.S. Environmental Protection Agency's Contaminant Candidate list for consideration of future regulation.

Are algae an issue for water systems?

Yes. Algae are present in all surface waters and excessive growths can cause taste and odor problems, create difficulties for water filtration and pose potential health risks. There ae a number of different types of algae. The ones of greatest concern are blue-green algae, because they can produce toxins that may be harmful to human health.

What can we do if we suspect blue-green algae are in our source water?

First, monitor and sample. Not all blue-green algae produce toxins and among those that do, toxins occur only a portion of the time. There are a number of labs in Maryland and throughout the country that can identify algae species and provide density counts. This type of analysis usually costs $60 to $125, depending upon the type of analysis and requested turnaround time.

NOTE: If a visible bloom is present, treat it as potentially harmful and use algaecide very carefully. Algaecide can cause the algae to rupture and release toxins into the water.
Toxins are more difficult to remove when they are outside the cell than when contained within it. Also, if you decide to use algaecide, consider switching to another water source while treatment is under way. Use on NSF International ™ approved algaecides.

Can our water treatment plant remove blue-green algae and algal toxins?

Yes. Water treatment plants are capable of removing microorganism much smaller than algae. Removing the algae will remove most associated toxins since growing intact cells contain 70 to 100 percent of the toxins. When cells rupture or die, they tend to release the toxins into the water.

- ***Minimize peroxidation* – Preoxidation with chlorine and ozone can cause algae cells to rupture, thus releasing toxins (In some cases, peroxidation will be necessary to meet Giardia and virus inactivation requirements, so Preoxidation can only be reduced and not eliminated)**

- ***Adjust coagulation, sedimentation, and filtration* – Careful monitoring and adjustment of coagulation and filtration processes may improve algae removal. Intact cells removed by these processes will significantly reduce the possibility that toxins will be present in the finished water.**

- ***Don't recycle backwash water* – Backwash water can contain high concentrations of algae that may rupture and release toxins.**

- ***Adjust post-filtration disinfection* – Once the algae cells are removed from the water, soluble toxins can be destroyed by chlorine and ozone, which are strong oxidants. Effectiveness varies depending upon the dose and the algal toxin. Microcystins can be destroyed by free chlorine at a dose of 0.5 mg/L for 30 minutes and pH of less than 8.0. Post-clarification ozone can destroy microcystins, nodularin and anatoxin-a when the dose is at 2.0 mg/L. Activated carbon has also proven to remove many soluble** toxins very well at a dose of 25 mg/L with a contact time of 30 minutes.

Some other algal toxins are more resistant to oxidation, so longer contact times and higher doses are required before significant destruction will occur. The references cited at the end of this Q&A are recommended sources for more detailed information on water treatment processes to remove algae and their toxins.

Other solutions include relocating the intake and using powdered activated carbon (PAC) granular activated carbon (GAC), or ozone in the water treatment plant. Both PAC and GAC are capable of removing algal toxins from the water, while ozone is a more powerful and effective oxidant than chlorine. Effectiveness of these processes depends on the type of toxin and other parameters.

What should we do if blue-green algae are detected?

Make any necessary adjustments to your treatment process. Also, consider sampling for algal toxins. The type of toxins produced will vary with the type of algae as summarized below.

Cyanobacteria	Toxins Produced	Type of Toxin
Anabaena	Anatoxin, Saxotoxin Microcystin	Neurotoxin Hepatotoxin
Aphanizomen	Anatoxin, Saxotoxin Cylindrospermopsin	Neurotoxin Hepatotoxin
Cylindrospermopsis	Cylindrospermopsin Saxotoxin	Hepatotoxin Neurotoxin
Microcystis	Microcystin	Hepatotoxin
Planktothrix (Oscillatoria)	Anatoxin Cylindrospermopsin Microcystin	Neurotoxin Hepatotoxin

There are a limited number of labs that analyze for algal toxins but some can only analyze for microcystin. Cos varies from around $300 to $500, depending on the type of analysis and requested turnaround time.

How can we prevent future algae blooms?

Blue-green algae thrive in warm, stagnant waters that have significant concentrations of nutrients. Phosphorus is frequently a limiting nutrient. Steps should be taken to control phosphorous from entering the water body through fertilizer runoff, septic systems and other sources. Additional prevention techniques include increasing water flow through the lake or reservoir, artificial circulation of water within the reservoir and improved watershed management activities may take years to effectively implement but are the most useful techniques for protecting water supplies.

Lake Franklyn Montgomery County Summer 2013
Photo by WTOP Kate Ryan

ADDITIONAL READING

WHO, 1999. Toxic Cyanobacteria in Water: A Guide to their Public Health Consequences, Monitoring and Management. World Health Organization, Geneva

EPA Cyanobacteria and Cyanotoxins: **Information for Drinking Water**. http://www2.epa.gov/sites/production/files/2014-08/documents/cyanobacteria_factsheet.pdf

EPA CyanoHABs Nutrient Policy and Data 2015
http://www2.epa.gov/nutrient-policy-data/cyanohabs

A review of cyanobacteria and cyanotoxins removal/inactivation in drinking water treatment.
Westrick JA[1], Szlag DC, Southwell BJ, Sinclair J. (Abstract) 2010

http://www.ncbi.nlm.nih.gov/pubmed/20502884

MARYLAND RESOURCES

DHMH: Environmental Health Helpline 1-866-703-3266

E-MAIL: dhmh.envhealth@maryland.gov

ACKNOWLEDGMENTS

This document is an adaptation of information provided by the Oregon & Washington Departments of Health. Maryland HABS program would like to thank both Health Departments for allowing adaptation of their materials.

Lake Williston Girl Scouts Camp
Maryland 2014


Potomac River 2015
Photo from Roger K. Everton
Virginia Dept. of Environmental Quality